CHESEMORE, DAVE

197

THE STATUS OF THE BROWN BEAR IN ALASKA[1]

David R. Klein, Willard Troyer and Robert A. Rausch
Bureau of Sport Fisheries and Wildlife, Juneau, Alaska

The brown bear in Alaska has been the subject of mounting public concern in recent years. On Kodiak Island, conflicts with cattle interests have threatened the welfare of the brown bear for many years. Increased trophy hunting, intensive oil prospecting and construction of defense installations on the Alaska Peninsula have been coupled with recent reports of decreases in numbers of brown bears there. In Southeast Alaska the advent of large scale pulp logging forecasts a changing environment for the brown bear in that area. Essentially, all of the log production for the new Sitka pulp mill will be from Baranof Island and the other adjacent brown bear islands.

Responding to the apparent increased pressure of civilization on the brown bear in Alaska, conservation organizations in both Alaska and the United States have been outspoken in their requests for added protection for this unique species.

Harvest of brown bears was greatest shortly after the turn of the last century when market hunting for hides, trophy hunting and wanton killing accounted for large numbers of bears annually. In 1925, with the establishment of the Alaska Game Commission and the enactment of the Alaska Game Law, the selling of bear hides was prohibited. This action, along with increased law enforcement, greatly reduced the annual kill of bears and allowed populations to increase to levels more consistent with the potential of the habitat. Additional restrictions have been placed on the taking of bears in more recent years and presently a special ten dollar license is required for the taking of brown or grizzly bears in addition to a regular hunting license.

On Kodiak Island brown bears have received the protection of the Kodiak National Wildlife Refuge and bear population studies have been underway there for several years. Elsewhere in Alaska brown bears have received little attention until this year when studies were initiated by the Fish and Wildlife Service[2] both on the Alaska Peninsula and in Southeast Alaska. In Southeast Alaska the Forest Service is cooperating in the studies. In addition to the specific local aspects of the studies, general information is being collected from all available sources. Bear kill information and general bear observation data are collected from guides, hunters, woods crews, stream guards and others to supply information on trends in size of bears killed, trophy size, hunter success, population composition and other aspects

---

1/ Presented at the 9th Alaska Science Conference, University of Alaska, College, September 5, 1958.

2/ Undertaken in part with Federal Aid to Wildlife Restoration Funds under Alaska Pittman-Robertson Project Number W-3-R.

of the life history of the animals.

Kodiak-Afognak Islands:

The Kodiak-Afognak Island group continues to sustain a fairly high population of brown bears in the face of continued heavy hunting pressure. Major islands supporting bear populations are Kodiak, Afognak, Shuyak, Raspberry and Uganik. The entire Island group consists of rugged, mountainous terrain with wide variations in vegetative types. The greater portion of Afognak, Shuyak and northeastern Kodiak are covered with a climax spruce forest. The southern tip of Kodiak consists of a tundra type and the greater portions of Kodiak, Uganik and Raspberry Islands are covered with a dense growth of alder, willow and elderberry thickets interspersed with dense grasses. The southern and northwestern portions of Kodiak Island are drained by long streams that receive good escapements of salmon during spawning seasons. This area is considered the ideal habitat for bears and supports the densest population in the Island group.

In 1940 the U.S. Government set aside a large portion of Kodiak Island as a National Wildlife Refuge to assure a natural feeding and breeding range for the Kodiak bear. All of the Island was included in the Refuge except the Chiniak Peninsula and a one-mile strip around the perimeter which was excluded for purposes of cattle grazing, cannery sites and other small industries.

This mile-strip is an important segment of the brown bear range on Kodiak Island. Potential use of this strip for cattle grazing with the known incompatibility of bears and cattle threatened to jeopardize the bear population. The situation was resolved early in 1958 by the compromise measure of bringing the mile-strip into the Refuge and releasing the Shearwater and Kupreanof Peninsulas adjacent to Chiniak for cattle grazing purposes. The Refuge now consists of 1,600,000 acreas of optimum bear habitat on Kodiak and Uganik Islands.

No accurate method of determining the total bear population on these Islands has been developed. In 1953, Hoffman estimated the total bear population on Kodiak and Uganik Islands at 1,669 animals. This figure was based on minimum counts, kills and general knowledge. The total population is believed to be somewhat reduced at present due to elimination of bears in the cattle grazing areas. This will continue until those areas set aside for cattle grazing purposes have been completely occupied. On the remainder of the Island healthy populations still remain, but may be reduced in certain drainages.

No major habitat changes have occured on Shuyak, Raspberry and Uganik Islands. Only one small logging operation on Afognak Island exists and this is not an extensive operation and has not greatly affected the bear population on that Island. Bears on the forested islands do not seem to be as numerous as on Kodiak and average density is probably about 1/5 as great.

The Kodiak bear has been subject to heavy hunting pressure for a number of years. The late Charles Madsen started guiding hunters in this area in 1928. During the pre-World War II years, from 1930-1940, the average annual trophy harvest was 25 bears. At this time the illegal kill by fisherman and the take by natives for food purposes exceeded the trophy kill. Little hunting occurred during the war years, but in postwar years popularity of the Kodiak bear as a trophy rapidly increased and by 1949 the annual harvest exceeded 100 animals. Since then the annual kill has fluctuated between 157 and 225 as shown below:

1950	171
1951	161
1952	178
1953	225
1954	212
1955	193
1956	201
1957	157

The kill continued to increase until 1953 when it peaked at 225 animals. This was thought to exceed the annual population increment and the season for Kodiak Island was reduced 34 days in 1954. In 1957 this reduction was put into effect on the entire Island group. Lengthened hunting seasons on deer and elk in the Islands attract local hunter-interest away from the bears and a decrease in Kodiak military personnel has also reduced hunting pressure. The shorter season and reduced hunting effort have lowered the annual take.

The illegal kill has also been lowered in the past few years for two major reasons: (1) The Fish and Wildlife Service has initiated an intensive fish restoration program and the placement of stream guards at the mouths of salmon streams curbs killing of bears by fishermen. (2) A number of citizens in Kodiak now derive a portion of their income from guiding bear hunters. This places a direct monetary value on the bear which is realized by the local fishermen.

The Kodiak bear contributes significantly to the economy of the Kodiak community. Most guides charge a fee of $750 to $1500 per bear. This fee alone contributes over $100,000 annually to the town of Kodiak. Usually 30 to 35 personnel are employed part time during the hunting season. In addition, an average of 10 to 12 bears are used for food annually by natives in the various villages.

At present 75 to 80 percent of the annual kills are taken for trophies. The illegal kill and bears taken for food purposes

constitute the other 20 to 25 percent.

Most hunters are looking for large trophy bears and thus selective hunting for the larger animals occurs. Since adult females are smaller than males, a larger female take and smaller average hide measurements would indicate excessive hunting pressure and eventually a reduced population. Since 1951, hide measurements and sex ratios of the harvest have been recorded as follows:

	Squared Hide Measurements	Sex Ratio (Percent)	
		Male	Female
1951	8' 10"	63	37
1952	8' 9"	57	43
1953	8' 9"	67	33
1954	8' 8"	65	35
1955	8' 9"	66	34
1956	8' 7"	64	36
1957	8' 9"	59	41

The consistancy of these figures exhibits the tendency for the trophy size to remain relatively uniform, and no major deviations from the size pattern or sex ratio is presently apparent.

To secure more knowledge of distribution, densities and population compositions and trends, aerial counts were flown over the major drainages during the summer of 1958. Counts were made during periods of salmon spawning activities when bears are concentrated on the streams. Of 390 bears classified, 297 or 76.1 percent were two years old and older. Fifty-two or 13.4 percent were cubs of the year and 41 or 10.5 percent were yearling cubs. If this variation between cubs and yearlings is constant each year, it would indicate a substantial natural mortality rate during the first year; however, the average cub litter was 2.30 and the average yearling litter, 2.25, which would not denote a great loss the first year. This variation suggests insufficient sample size.

To secure information on the extent of bear movements and other life history data the Fish and Wildlife Service initiated a live-trapping and ear-tagging program in 1957. This study is still in the experimental stage. Similar techniques developed by Michigan and New York on black bears are being used. Both culvert type traps and #150 steel traps have received limited use. At present it appears that the #150 steel trap converted for this purpose can safely hold brown bears without injury. The steel trap also has proved the most economical and efficient for trapping bears. Brown bears are much more wary than blacks and are very reluctant to enter the enclosed

culvert traps.

Problems of handling the captured animals are more difficult. Small bears have been handled by hog-tying and applying ether. To develop methods for handling larger bears experiments are being conducted with the Cap-chur Gun, manufactured by the Palmer Chemical and Equipment Company, Atlanta, Georgia. This gun delivers a dart filled with a liquid drug which is injected on impact with the animal. Once the trapping and tagging techniques are perfected an opportunity will be available to secure mobility and longevity data so essential to a sound bear management program.

The Alaska Peninsula:

Prior to 1958 no quantitative data pertaining to numbers or population trends of the Alaska Peninsula brown bear existed. The harsh climate, remote location and great expense and effort involved in hunting bears on the Peninsula have until recently discouraged trophy hunting in this area. Illegal kills by commercial fishing interests and indigenous persons were known to occur and were reported to be very excessive in some areas. The present legal kill on the Peninsula is estimated to not exceed 50-75 animals annually. The illegal kill is more difficult to assess. Commercial fishing interests have long waged war on the Peninsula bear and many fishermen reportedly kill bears whenever the opportunity presents itself.

During late July and early August of 1958, a Cessna 180 and two wildlife management agents were assigned to bear patrols on the Alaska Peninsula. No illegal kills were observed. However, carcasses of several bears were found. Unfortunately, many of these kills fall into the quasi-legal status of having been killed near or in villages. A total of seven kills was observed. The distribution of kills is as follows: Port Moller--3; Naknek area--2; Settlement Point--1; and Nelson Lagoon--1. Bears killed on the beaches probably would be washed to sea; also, much of the Pacific side of the Peninsula was not adequately surveyed. However, during the fishing season when fishermen are naturally most active away from the villages, relatively few bears are adjacent to the coastal areas. The bears are perhaps most vulnerable to humans during the spring in May and early June, when they are feeding on salt grasses along the beach. This period normally occurs during the open hunting season on bears. Eliminating illegal killing of brown bears on the Alaska Peninsula will be a most difficult task. Many of the natives and commercial fishermen are convinced that brown bear and salmon are not compatible. The killing of bears around centers of population is probably inevitable.

In 1955 salmon escapement into most of the drainages on the Bering Sea side of the Peninsula between Port Heiden and the Kvichak River system was unusually poor. Coincident with the shortage of fish was a failure of the berry crop. This assumed food shortage was followed by a most severe winter during which numerous reports on "non-hibernating" bears were received. Several residents of the Naknek-King Salmon area have

attributed the reported decline of bears to the above combination of factors.

Since 1955 salmon escapement into the drainages of the problem area have been erratic and reports of a decrease in bear numbers have continued. However, these reports were frequently conflicting and few of the observations which formed the basis for the reports were conducted in a systematic manner.

In an effort to obtain quantitative data necessary for evaluating the welfare of the bear population and for developing indices of total numbers, an aerial survey of the Peninsula bear habitat was planned and conducted during the summer of 1958.

Initially the plan for the aerial survey was to conduct at least one count on each of the major drainages from Cold Bay to a line extending roughly north-south along the Kvichak River, across Iliamna Lake, to Chinitna Bay. Weather, for which the Peninsula is famous, prevented completion of this objective. However, counts were made on every major stream on the Bering Sea side of the Peninsula from Port Moller to the Kvichak River. Coverage on the Pacific side was considerably less than 50 percent and only the NcNeil River and those drainages east of it were adequately sampled. The counts were made between July 24 and August 22, using a 150 Supercub on floats.

There are a number of variables seemingly inherent to aerial observations which tend to reduce the number of bears counted. These are briefly listed below in what is their assumed order of importance.

1. Concealment afforded to bears by dense vegetation.
2. Response of bears to aircraft.
3. Tendency of bears not actively feeding on salmon to "lie up" in areas away from the stream.
4. Failure or lack of time to check every lateral tributary in a drainage.
5. Turbulent air.
6. Observers failing to see bears due to eye fatigue.

The proportion of the bears seen versus the actual number present is problematical and certainly varies considerably from one terrain and vegetation type to another. Troyer (viva voce) indicated that on Kodiak he believed that considerably less than 50 percent of the bears were seen. Conditions for aerial observations of bears vary greatly on the Alaska Peninsula where the vegetation varies from a spruce-birch forest-type around Iliamna Lake to open heath intersperced with occasional clumps of alder at Moffet Bay. Air-ground count comparisons made this year generally revealed that roughly 50 percent of the bears

were seen from the air in moderately dense alder-willow vegetation. More research is needed to evaluate the effects of these variables associated with aerial observations.

A total of 779 different bears were observed. The bears were classified into three categories:

1. Sows with cubs of the year.

2. Sows with yearlings.

3. Other bears presumably 2 years and older.

Initially a subadult category was included; however, identification of subadults from the air did not prove feasible and this category was discontinued. Seventy-seven sows with cubs of the year were seen. The sows were accompanied by a total of 167 cubs, yielding an average litter size of 2.17 cubs per sow. The frequency of litter size was as follows: sows with 1 cub--18; sows with 2 cubs--32; sows with 3 cubs--23; sows with 4 cubs--4. Fifty-six sows accompanied by yearlings were observed. The sows were accompanied by a total of 115 yearlings yielding an average litter size of 2.05. The frequency of litter size is as follows: sows with 1 yearling--11; sows with 2 yearlings--31; sows with 3 yearlings--14; sows with 4 yearlings--0. This data is not significantly different from the Kodiak Island data in Table 1 in view of the sizes of the samples involved. Other bears, presumably 2 years and older, accounted for the remaining 364 bears counted. Thus, of the 779 bears counted, the identifiable sex and age composition is as follows: cubs of year--21 percent; yearlings--15 percent; sows (those with cubs or yearlings)--18 percent; and other bears--46 percent.

Several major concentrations of bears were observed while making the survey. Perhaps the most widely publicized area is the McNeil River Bear Reserve where a series of low falls make migrating salmon available to the bears. Here 44 bears were counted from the air, while a ground observer indicated that at least 87 bears were using the falls area at the time of the aerial survey. Major bear concentrations were observed at additional areas. Ninety-five were observed at Moffet Bay, 74 at the Black and Chiguik Lake system, 70 at the Meshik and Aniakchak River system, 33 at Sandy Lake and 32 at the Ugashik Lakes.

In one area which had a reported decrease in bear numbers, the Bering Sea drainages from Port Heiden to Lake Iliamna, bears were present on all streams sustaining substantial salmon escapements. The distribution of bears and the many variables involved precluded comparison of this area with other Peninsula areas. Certainly a decrease may have occurred. This decrease may have been a loss by death or movement to more favorable areas. Bears regularly move from one coast to another and invariably concentrate on streams supporting good escapements of salmon. Much work needs to be done on

population identity, movements and the factors affecting movements, particularly with respect to salmon escapements and berry crops.

Southeast Alaska:

In Southeast Alaska the brown bear is restricted in distribution to the mainland and Admiralty, Baranof and Chichagof Islands of the Alexander Archipelago. Greatest densities occur on the islands while abundance on the mainland is localized around the larger river valleys that penetrate the Coast Range.

Fortunately, in the past, economic development has not greatly effected the brown bear or his range in Southeast Alaska. The large centers of human population, with the exception of Sitka, are located on the mainland or the islands south of the brown bear range. Major use of the land has been restricted to cannery sites, fishing camps, fox farming, small scale logging and mining and all of these activities have decreased in recent years with the exception of logging. Most trophy hunting is concentrated on Admiralty Island and the east coasts and inlets of Baranof and Chichagof Islands. Concentration of hunting effort is usually determined by relative abundance of bears, accessibility and the location of suitable, small craft harbors.

Annual harvest of brown bears in Southeast Alaska has increased only slightly since records were first kept in 1932. The estimated harvest then was 75 animals, with 15 of these being by non-resident trophy hunters. In more recent years the kill for Southeast Alaska has fluctuated around 100 annually.

Prior to 1932 no basis for estimates of brown bear numbers on Admiralty, Baranof and Chichagof Islands was available. In 1932, as a result of mounting public concern for the welfare of the brown bear on the islands of Southeast Alaska, the U.S. Biological Survey and the Forest Service censused the bears on Admiralty Island by counting and differentiating tracks adjacent to salmon streams. This survey, made from August 10 - September 10, when salmon were spawning in the streams, indicated 900 bears on Admiralty Island. Similar surveys made by the Forest Service in 1938 and 39 produced bear counts of 940 on Chichagof Island and 445 on Baranof Island.

In the spring of 1958 the Fish and Wildlife Service initiated a study of brown bears in Southeast Alaska and by mid-summer the Forest Service was able to cooperate in the study by furnishing both personnel and operating funds. Objectives of the study are to determine relative numbers and population trends of brown bears on Admiralty, Baranof and Chichagof Islands as a basis for evaluation of the effects of logging on brown bear populations and for comparison with results of bear surveys made in the 1930's. Initial emphasis of the studies is being directed in those areas adjacent to Sitka, where logging for the new Sitka pulp mill is planned within the next five years, and on southern Admiralty Island, where relative abundance of bears

is high, hunting pressure is heavy and where logging by small operators is already under way. The studies are planned to yield information necessary to formulate forest management practices which will insure the welfare of the brown bear populations in association with large scale logging.

During the first season much effort was directed toward developing and testing field techniques and field work was planned accordingly.

1.) Composition counts were made during May when bears are readily observed at twilight hours feeding in the sedge meadows at the heads of the bays. This work was done principally in Pybus and Gambier Bays on the south end of Admiralty Island where conditions are most favorable for observations of large numbers of bears. Results of this spring's counts in which 81 bears were tallied, indicate that complete sex and age ratios cannot be obtained by this method. However, some insight into the welfare of the bear population can be obtained from sow:yearling cub ratios which are obtainable at this time.

2.) Aerial counts were attempted during May and throughout the summer to determine their effectiveness for censusing total bear numbers and for obtaining adult:cub ratios. Indications from aerial counts made to date are that the densely timbered terrain in Southeast Alaska renders this method ineffective for censusing total bear numbers with the possible exception of counts of bears in the early spring on the sedge meadows. These early spring counts may be useful as an index method of population census. The aerial counts as a source of adult:cub ratios are useful and practical both in early spring and mid-summer when many of the bears are in open alpine areas.

3.) Duplication of the track count method of bear censusing used in the 1930's was made on the top priority areas adjacent to Sitka and on southern Admiralty Island to test the accuracy of this method and to secure data which would be of a comparable nature. The following excerpt from the 1932 Admiralty Island count, by Dufresne and Williams, illustrates the method used:

> "In estimating the bears along the creeks, we were guided by several factors. First and foremost was the highly individual tracks of the animals. They were different in size, different in shape, with other more or less noticeable characteristics which would enable us to recognize them from any other tracks. During the first two or three days in the field all four members of the expedition worked together in an effort to arrive at some uniform method and by diligent examination and study we came to an agreement that the most reliable measurement we could take was the width of the bear tracks across the toes. Such measurements ranged from 3¼ inches for cubs to 8½ inches for old bears. Taking into consideration the medium in which the tracks were made, measuring the same track over and over again where the animal

had walked over gravel bars, sand flats and mud holes, we found that we could secure reliable measurements within a quarter of an inch, and further that we could recognize the same track if encountered at other places. Additional strength was given this method by also taking the length of the track from heel pad to middle toe, exclusive of the nail, whenever possible, but by itself this was not a reliable measurement owing to slippage, nature of soil, etc., and must be secondary to the measurement across the toes. We were further aided in this by the fact that some bears had long, narrow soles; others were broad and rounding as though the animal had suffered fallen arches, while others were ham-shaped."

In conducting the current track counts, Forest Service and Fish and Wildlife boats and personnel met in Gambier Bay on Admiralty Island on August 4 and worked southeast and north around to Hood Bay, walking all potential salmon streams in the area. Five field crews of two men each worked from the boats and were shuttled to the heads of the streams by helicopter and made the track counts while returning to salt water.

Ideally, the track counts should be coordinated with the peak of the salmon runs when bears are concentrated on the streams. However, chronological variation in salmon escapements within any given area necessitated planning field work to coincide with suitable conditions on the greatest portion of streams. In order to evaluate numbers of bears not utilizing the salmon streams during the period of the counts, aerial and ground coverage of alpine areas adjacent to the streams was made.

The actual procedure of measuring and differentiating bear tracks was nearly identical to that used in the 1930's. Measurements of track width, taken across the toes, and length from the tip of the middle toe, exclusive of the claw, to the end of the heel pad were taken on all sets of tracks located on the streams. In addition, the width of the fore pad print was taken, as our studies showed that this was less subject to variation due to the nature of the ground than other measurements. Note was made of the type of ground surface in which each track was made as an aid in the evaluation of similar tracks. In addition to the actual measurements of bear tracks on the streams walked, other pertinent observations were recorded, such as numbers and extent of salmon in the streams, location of salmon obstructions and additional evidence of bears present. This related information was an aid in the assessment of the effects of variable environmental factors on numbers and concentrations of brown bears.

The Sitka area track counts were made in a similar manner, however, they were not started until August 27 as the salmon enter the spawning streams much later in that area.

Results of the track count have not been completely analysed, however, it is evident that they are subject to considerable variation due to changing and difficult to evaluate environmental factors. The 1932 counts, for instance, yielded a figure of 362 bears for the same salmon streams that our Admiralty Island count covered this summer. Our total figure for these streams was 187 bears. During the summer of 1932 there was a good salmon escapement, however, the berry crop was poor. Our counts during the past summer were made during a year of poor salmon escapement but excellent berry production. Apparently more bears were attracted to the salmon streams in 1932 by the abundance of salmon, while in 1958 the scarcity of salmon and the good berry crop had the opposite effect. To compensate for bears not in the areas around salmon streams Dufresne and Williams increased their 1932 counts by ten percent. We estimated that approximately forty percent of the total bears in the study area were feeding on vegetation and berries away from the salmon streams. This estimate was based on bear sign and bears seen by walking random transects from alpine areas to sea level. The corrected numbers of bears estimated in the study area from the two surveys are, 1932 - 398 and 1958 - 312. In reviewing the 1932 stream track tally sheets we felt that the estimate of bears on the streams was exceedingly high in view of the number and variation of the tracks measured. Conversely, the ten percent estimate of bears not on the salmon streams appeared too conservative.

4.) Additional studies are being set up with the Forest Service to determine the immediate effects of timber removal and logging practices on bears and their habitat. This will include the establishment of permanent plots to record changes, resulting from logging, in the vegetation and small mammal populations which may affect bear populations. Methods of reducing contacts between loggers and bears which may be detrimental to either or both parties are being tested for incorporation into logging procedures.

Our studies are just getting started and will require considerable time to give us many of the answers needed for a sound bear management-timber-use program. However, the welfare of the brown bear in Southeast Alaska can be guaranteed in the face of large scale pulp logging if wise land-use practices are employed which take into consideration the points where conflicts of interests may exist. Certainly cutover land will produce a wider variety and greater quantity and quality of vegetative material important in the brown bear's diet than the shaded floor of the rain forest. If excessively large clearcuts, which can be detrimental to the salmon streams, are avoided, the altered habitat following logging should be more favorable for bears than the old over-mature forests were.

Proper garbage disposal facilities and location of logging camps away from the salmon streams and tidal flats will minimize contacts between bears and loggers. Strict regulations governing logging procedure are essential to prevent damage to the salmon streams through destruction of spawning beds, disruption and blocking of stream channels, excessive runoff and siltation or loss of the

stream bed seal.

Brown bears and logging can be compatible; however, in the rapid development of the timber resources in industry-starved Alaska, the brown bear will need support from every possible source in order to insure its welfare.

TABLE 1 AVERAGE BROWN BEAR LITTER SIZES FROM THREE ALASKA AREAS

Area	Cubs of the Year		Yearling Cubs	
	Average Litter Size	Sample Size	Average Litter Size	Sample Size
Kodiak (1952-56)	2.42	---	2.24	---
Kodiak (1958)	2.30	52	2.25	41
Alaska Peninsula (1958)	2.17	167	2.05	115
Southeast Alaska (1958)	---	---	1.94	54

LITERATURE CITED

Bevan, Donald E. Personal communication, April 11, 1956.

Defresne, Frank and Jay P. Williams 1932. Admiralty Island bear estimate. Alaska Game Commission and U.S. Forest Service, 8 pp. mimeo.

Erickson, Albert W. 1957. Techniques for live-trapping and handling black bear. Transactions of the Twenty-Second North American Wildlife Conference.

Heintzleman, B.F. 1934. A plan for the management of brown bear in relation to other resources on Admiralty Island, Alaska. U.S. Dept. of Ag. Misc. Pub. No. 195, 20 pp.

Shuman, Richard F. 1947. Bear depredation on red salmon spawning populations in the Karluk River system. Journal of Wildlife Management, January 1950, Volume 14, No. 1.

Shuman, R.F., Nelson, P.R., Clark, W.K., Hoffman, R.R. 1955. Further studies of bear predation on salmon spawning populations on Kodiak Island. Unpublished report of the Fish and Wildlife Service, Juneau, Alaska